Pest Management Regulatory Agency
Agence de réglementation de la lutte antiparasitaire

Re-evaluation Note

REV2007-01

Update on the Re-evaluation of Chlorpyrifos

The purpose of this Re-evaluation Note is to notify registrants, pesticide regulatory officials and the Canadian public of the status of the re-evaluation of chlorpyrifos.

This Re-evaluation Note summarizes the major comments made to Health Canada's Pest Management Regulatory Agency (PMRA) in response to Proposed Acceptability for Continuing Registration (PACR) document PACR2003-03, *Phase 2 of the Re-evaluation of Chlorpyrifos*, published on 18 March 2003. This document also provides the PMRA's response to the comments.

Based on the review of currently available information, the PMRA is requiring interim mitigation measures be implemented to further protect workers and the environment.

The PMRA will undertake a refined environmental risk assessment by 2008 and will make a final decision on the acceptability for continuing registration of chlorpyrifos after that assessment is completed.

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1.0 Introduction

The re-evaluation of chlorpyrifos is being carried out in three phases. In consideration of the risks to human health and the environment identified in the first phase of the re-evaluation, the PMRA implemented a phase-out of most residential uses of chlorpyrifos, discontinued the use on tomatoes and lowered maximum residue limits (MRLs) for chlorpyrifos residues in imported apples and grapes. These mitigation measures and the time frame for their implementation were similar to those being implemented in the United States. The regulatory decisions taken as a result of Phase 1 were announced in Re-evaluation Note REV2000-05, *Chlorpyrifos*, published on 28 September 2000.

The second phase of the re-evaluation has focussed on the remaining agricultural and forestry uses of chlorpyrifos. On 18 March 2003, the PMRA published Proposed Acceptability for Continuing Registration document PACR2003-03, *Phase 2 of the Re-evaluation of Chlorpyrifos*. In this document, the PMRA proposed measures to further mitigate environmental and occupational risks as well as announced that the PMRA would take a tiered approach to the environmental assessment for chlorpyrifos. The PMRA received comments on the proposal from growers' organizations, pesticide application associations, registrants, federal and provincial government departments, university scientists as well as private individuals.

This Re-evaluation Note presents a summary of the comments received and the PMRA's response. This document also outlines the interim mitigation measures that are required pending finalization of the third and final phase of the re-evaluation of chlorpyrifos.

1.1 Phase 3 of the Re-evaluation

In Phase 3 of the re-evaluation of chlorpyrifos, the PMRA will undertake a refined environmental risk assessment. The PMRA's environmental assessment is based on an identification of hazards to non-target organisms. Measures to reduce environmental exposures are identified and implemented where warranted (e.g., removing uses that are obsolete, reducing the number of applications, requiring buffer zones to protect sensitive habitats).

A tiered approach to environmental risk assessment is necessary in cases when there are little data on field concentrations and/or on adverse effects, or when the initial environmental assessment indicates high hazard, but there is considerable uncertainty with regard to the frequency and magnitude of exposure and effects. A tiered approach allows for refined ecological risk assessment methods to be developed and implemented, for additional data to be provided to refine the assessment as well as existing alternatives to be considered and new ones to be developed. Furthermore, a tiered approach makes the most efficient use of assessment resources.

In the case of chlorpyrifos, the initial (Tier 1) assessment described in PACR2003-03 indicates potential environmental concerns for certain uses including aerial application for agricultural commodities, airblast application for peaches and nectarines as well as applications for mosquito larvae control. The acceptability for continuing registration of these uses will be revisited in Phase 3 of the re-evaluation in light of the results of a refined environmental assessment and the

availability of alternatives. The 2008 timeframe for completion of the refined environmental assessment will allow for the development of refined assessment methodologies and the generation of additional data. A final decision on chlorpyrifos registration will be made after completion of Phase 3 of the re-evaluation.

2.0 Interim Risk Mitigation Measures

The PMRA has reviewed the comments received in response to PACR2003-03. A summary of the comments received and the PMRA's response to these comments are presented in Appendix I.
Based on the review of the available information and comments received, the PMRA is requiring that the interim mitigation measures described in this document are implemented pending finalization of Phase 3 of the re-evaluation of chlorpyrifos to further protect workers and the environment. Additional data requirements have been identified.

2.1 Interim Risk Mitigations Pertaining to Worker Risks

In order to mitigate concerns regarding worker safety, the measures described in sections 9.1.1 and 9.1.2 of PACR2003-03 must be implemented. These measures include the following:

a) discontinuation of paintbrush applications for indoor uses;
b) discontinuation of applications with high-pressure handwand equipment;
c) implementation of engineering controls and/or addition personal protective equipment (PPE) for handlers who mix, load and apply pest control products that contain chlorpyrifos; and
d) establishment of re-entry intervals for postapplication workers.

Details on the risk mitigation measures to be implemented for workers for the agricultural and non-agricultural uses of chlorpyrifos are outlined in Appendix II and III, respectively.

2.2 Interim Risk Mitigations Pertaining to Environmental Risks

The following interim mitigation measures address concerns identified in the Tier 1 environmental risk assessment for chlorpyrifos:

a) Buffer Zones to Reduce Exposure of Aquatic Ecosystems

The assessment of environmental risks indicates that mitigation measures are necessary to reduce exposure and potential acute risks to aquatic organisms (i.e., aquatic invertebrates and fish). Reducing spray drift and runoff potential are important considerations for the protection of aquatic organisms. Currently, no spray buffer zones are required for products containing chlorpyrifos. Consistent with the approach for new products that pose a risk to sensitive habitats/organisms, buffer zones will be implemented for groundboom, airblast and aerial applications. A reduction of drift to some degree can be achieved through specific buffer zones, thereby mitigating potential exposure and effects. Comments received regarding the proposal for buffer zones and the PMRA response to

these comments are summarized in Appendix I. Details regarding the buffer zones required to protect aquatic habitat are summarized in Appendix II.

b) Additional Precautions to Protect Bees

Precautionary statements regarding hazards to bees must be added to the labels of all products with agricultural uses, as indicated in Appendix II.

2.3 Phase-out of Label Uses

In PACR2003-03, the PMRA proposed to discontinue certain label uses considered to be of limited value. Based on the use pattern information available to the PMRA at that time, the discontinuation of these uses was estimated to have minimal impact on the pest management options available to growers. The PMRA received comments on this proposal as well as new use information from a variety of stakeholders including provincial governments, universities, growers' groups and registrants. Based on the comments and the new information received, the PMRA acknowledges that a phase-out of some of the uses included in the initial proposal could negatively impact pest management in certain crops. Therefore, some of these uses are maintained for a variety of reasons relating to the value of the product.

a) Lack of viable alternatives for rotation with the synthetic pyrethroids for resistance management:
- various cutworm species on canola, cole crops, corn, lentils, peppers, potatoes, sugarbeets and tobacco
- grasshoppers on lentils
- corn rootworm on corn

b) Cyclical increases in pest pressure:
- grasshoppers on lentils

c) Lack of registered alternatives for the control of subterranean cutworms:
- various cutworm species on canola and tobacco

d) Recent reported use of chlorpyrifos
- cutworm and seedcorn maggot on tobacco

e) Lack of viable alternatives
- seedcorn maggot on tobacco

Appendix II summarizes the agricultural uses of chlorpyrifos that will be allowed on labels, together with the required mitigation measures and use limitations for protection of workers and the environment. Appendix III summarizes the non-agricultural uses that are allowed on labels, as determined in Phase 1 of the re-evaluation, together with the mitigation measures and use limitations that are now required for protection of workers.

2.4 Reduction in the Maximum Number of Applications

Measures to reduce risks to human health and the environment include limits on the maximum number of applications permitted per season per crop. These limitations are based on the value assessment for chlorpyrifos presented in PACR2003-03 and are expected to have a minimal impact on the pest management options available to growers. Details on these restrictions are presented in Appendix II of this document.

2.5 Uses Requiring Further Consultation

2.5.1 Peaches/Nectarines

As indicated in PACR2003-03, the PMRA acknowledges the value of chlorpyrifos as a resistance management tool in controlling Oriental fruit moth on peaches and nectarines given the limited number of effective pest control alternatives. However, the PMRA has concerns regarding the high application rates when chlorpyrifos is used on peaches and nectarines as well as the difficulty in mitigating terrestrial and aquatic risks associated with this use. Continuing registration of this use is acceptable in the short term, but will be revisited at the end of 2008 in light of the availability of any new alternatives and/or information.

2.5.2 Mosquito Larvicide Use

As part of the Phase 1 re-evaluation of chlorpyrifos, a decision was made to maintain registration for the larvicidal use of granular and liquid formulations of chlorpyrifos (aerial or ground application), at the request of certain municipalities in Alberta and Manitoba. Action was taken at that time to limit use only to temporary pools and to situations where integrated pest management principles are part of the control program, e.g., larval population surveys before treatment. Limiting use to temporary pools, as opposed to permanent water bodies, would mitigate potential for damage to certain non-target aquatic organisms (e.g., fish), which are very sensitive to chlorpyrifos. However, the PMRA acknowledges that this measure will not protect other non-target organisms (e.g., aquatic invertebrates, amphibians) that may live in or frequent temporary pools.

This position will be revisited at the end of 2008 in light of the availability of effective alternatives and/or new information. In the context of reassessing the PMRA's position on this use, the PMRA requests that the provinces and/or municipalities collect data (side-by-side trials) that compare the efficacy of registered products containing chlorpyrifos with that of alternative products under varying conditions relevant to Canada (e.g., water temperature, organic matter content of water, different genera of mosquitoes). The PMRA will consult with the provinces prior to making a final decision on this use pattern.

2.5.3 Applications by Aircraft to Agricultural Crops

Based on the initial environmental assessment, the PMRA is concerned about the environmental risks associated with chlorpyrifos and the potential effects on non-target aquatic and terrestrial organisms. Although spray buffer zones can mitigate the exposure of aquatic organisms from spray drift, options for mitigating exposures from runoff are more limited. Potential effects on terrestrial organisms (e.g., birds) are also difficult to mitigate due to the occurrence of non-target species in treated areas. Mitigation is particularly difficult with regards to aerial applications, which, in the case of chlorpyrifos, can involve treatment of large areas (e.g., for control of pests on canola and cereals across Canada or for grasshopper control in Western Canada).

However, the PMRA also recognizes that application by aircraft can be a valuable tool for growers, especially in situations where using ground application equipment is considered not practical or not feasible (e.g., in pest outbreak situations where large areas require treatment in a short period of time).

Prior to finalizing a decision on aerial uses of chlorpyrifos, the PMRA will consult further on the following:

- the value of aerial applications of chlorpyrifos compared with applications by other means (including the availability of alternatives for these uses);
- options for mitigating potential environmental effects associated with aerial use of chlorpyrifos (particularly with regards to effects on aquatic habitat from runoff and effects on birds); and
- identification of further data requirements to assist in refining the environmental risk assessment for aerial applications of chlorpyrifos (e.g., information on spray setup, data on interception rates for different crops, etc.).

Continuing registration of aerial uses of chlorpyrifos will be revisited by the end of 2008 in light of the outcome of the above consultations, any other new information and the completion of a refined environmental assessment. In the interim, and consistent with the approach used for new products, the PMRA will proceed with implementation of spray buffer zones for aerial uses of chlorpyrifos (as outlined in Appendix II) for protection of aquatic habitat from spray drift.

2.6 Data Requirements

In addition to implementing the mitigation measures described above, registrants must address the following data requirements.

2.6.1 Data Associated With the Active Ingredient

- **Drinking Water**
  Supplemental drinking water monitoring data are required, especially from areas where wheat or cole crops are grown, with concomitant chlorpyrifos use information from the areas surrounding sample collection.

- **Environmental Exposure**
  Data on exposure levels for non-target wildlife (birds and aquatic organisms) are required. In particular, surface water monitoring data in Canada are required to characterize the contamination of surface waters resulting from chlorpyrifos use on crops representative of the major crop groups (grains and oilseeds, and vegetables) on appropriate spatial and temporal scales.

2.6.2 Data Associated With Specific Uses of Chlorpyrifos

- **Greenhouse Ornamentals**
  Field crop dislodgeable foliar residue (DFR) data are not a suitable surrogate for greenhouse ornamentals. To confirm the acceptability of continued registration of chlorpyrifos for use on greenhouse ornamentals, appropriate chemical-specific DFR data or a suitable science-based rationale is required.

- **Mosquito Fogging Use**
  Fogging with chlorpyrifos for mosquito control is not currently reported to be a practice in any province. Should it become necessary due to public health concerns, confirmatory chemical-specific air monitoring data following ground-based mosquito adulticide application are required to quantify inhalation postapplication exposure. This is also a data requirement in the United States to support these uses, and these data must also be submitted to the PMRA once they become available.

2.7 Guidance to Registrants

The registrants have been informed by letter of the specific requirements, including data requirements as defined in Section 2.6 of this Re-evaluation Note, affecting their product registrations and the regulatory options available to comply with this decision.

List of Abbreviations

a.i.	active ingredient
bw	body weight
cm	centimetre(s)
CODEX	CODEX Alimentarius Commission
DFR	dislodgeable foliar residue
DMSO	dimethylsulfoxide
DNT	developmental neurotoxicity
EC	emulsifiable concentrate
g	gram(s)
GR	granular
h	hour(s)
ha	hectare
JMPR	Joint Committee on Pesticide Residues
kg	kilogram
km	kilometre(s)
L	litre(s)
m	metre(s)
mg	milligram(s)
mL	millilitre(s)
LD_{50}	lethal dose 50%
LOAEL	lowest observed adverse effect level
MRL	maximum residue limit
NAFTA	North American Free Trade Agreement
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
OMAF	Ontario Ministry of Agriculture and Food
PACR	Proposed Acceptability for Continuing Registration
PBPK	physiologically based pharmacokinetic
PMRA	Pest Management Regulatory Agency
PPE	personal protective equipment
USEPA	United States Environmental Protection Agency
WP	wettable powder

Appendix I Comments and Responses

The PMRA received comments regarding PACR2003-03, *Phase 2 of the Re-evaluation of Chlorpyrifos*, published on 18 March 2003 from growers organizations, pesticide application associations, registrants, federal and provincial government departments, university scientists as well as private individuals. The PMRA has summarized the main comments received on the health and environmental assessments and provides responses to the comments below:

1.0 Human Health Assessment

1.1 Comments on Toxicology Assessment—Reference Dose

A registrant challenged the PMRA reference doses established for children, questioning:

- the relevance of the neonatal rat model to predict sensitivity of the young;
- the data from Zheng et al. (2000); and
- the need for an additional safety factor for this population.

PMRA Response

Several processes involved in brain development that occur postnatally in humans including neurogenesis (specifically of the hippocampus), gliogenesis and synaptogenesis have been affected in experiments involving chlorpyrifos exposure (Garcia et al. 2002, 2003; Rice and Barone 2000; Slotkin et al. 2001). In addition, exposure to low doses of chlorpyrifos at what corresponds to the prepubescent period in rats has also been observed to cause deficits in cognitive function (Jett et al. 2001). Similarly, chlorpyrifos is well known to affect the role of cholinesterase. As neurotransmitters such as acetylcholine serve as both neurotrophic and morphogenetic signals, they may be responsible for the modulation of central nervous system development and will have the potential to interfere at many stages of development (Rice and Barone 2000). In addition, various studies indicate that the alterations in brain development may be mediated through mechanisms other than inhibition of cholinesterase.

The publication by Zheng et al. (2000) suggests that rat pups exposed during the first week following parturition are likely more sensitive to the anticholinesterase effects of chlorpyrifos. Sensitivity to the effects of chlorpyrifos has also been observed in several studies in which acute oral doses were administered on postnatal days 17 and 27 (Moser and Padilla 1998; Moser et al. 1998). While the doses used in the latter two studies are greater than an order of magnitude in excess of the no observed adverse effect level (NOAEL) identified in Zheng et al. (2000), they remain indicative of a sensitivity of pups that is likely to include the stages leading up to puberty.

A registrant contends that fetuses and pups appear to be similarly or less sensitive to repeated doses of chlorpyrifos. Based on cholinesterase inhibition data from the companion study to the developmental neurotoxicity (DNT) study, the PMRA agrees with this statement for fetuses. However, the lack of cholinesterase inhibition in the nursing pups is not surprising given that according to the registrant's calculations, the nursing pups were exposed to 0.1 mg/kg bw/day via the milk. The PMRA would not have expected cholinesterase inhibition given the NOAEL of 0.75 mg/kg bw/day established for cholinesterase inhibition in seven-day old pups following acute or repeat-dose exposure from the study by Zheng et al. (2000). The PMRA would further

point out that the pup cholinesterase inhibition measurements from the companion study were limited by inappropriate sampling time. Blood samples collected from pups two hours after their dams were dosed likely did not identify maximum cholinesterase inhibition levels as time to peak blood levels and maximum cholinesterase inhibition in adults is between three and six hours, not including the few hours necessary for pups to digest the milk (Mendrala and Brzak 1998). Consequently, numerical comparisons of the cholinesterase data (from the companion study to the DNT) regarding comparative sensitivity of adult and neonatal rats are not valid.

Diminished sensitivity of cholinesterase inhibition seen with repeat dosing of neonates in Zheng et al. (2000) is less than that noted with acute dosing, possibly due to synthesis of cholinesterase or enhanced detoxification activity. However, published literature (Pope and Liu 1997; Tang et al. 1999) suggests that recovery following repeat dose exposure may not be as rapid as with acute dosing in neonatal animals. Furthermore, additional uncertainty remains with the potential to affect brain development as discussed previously.

Data indicate that preweaned pups are more sensitive than adults to the effects of chlorpyrifos. While a considerable degree of development observed in neonatal rats is correlated with that of human in utero development, some development (including neurological development) is likely to correlate with that of postnatal development in humans. Thus, there remain considerable uncertainties in the extent of potential sensitivity and its relevance to the human child. In light of these uncertainties as well as the rat data indicating sensitivity of the young, an additional safety factor of 10-fold is required for the risk assessment of children up to 12 years of age.

1.2 Comment on Toxicology Assessment—Sensitivity of Rats

A registrant contends that increased sensitivity of rat pups is a high dose issue.

PMRA Response
Most studies investigating the sensitivity of chlorpyrifos have been conducted at doses within an order of magnitude from the effect levels used to establish reference doses. Considering the number of indicators of concern for pup sensitivity and the inherent uncertainties surrounding neurological development, it would be unreasonable to assume that the same sensitivity does not occur at the effect levels used to establish the reference doses.

1.3 Comment on Toxicology Assessment—Use of Gavage Studies

A registrant contends that the use of gavage studies in the establishing of reference doses may be inappropriate due to the bolus effect and "artificial" spike in systemic exposure.

PMRA Response
Dosing of some organophosphates by oral gavage is believed to establish lower effect levels for cholinesterase inhibition than by dietary administration. Animal studies conducted with chlorpyrifos are confounded by issues such as strain used, study duration and health status (i.e., pregnant vs. non-pregnant) that complicate this comparison. However, comparison of subchronic assays in which both gavage and dietary dosing regimes were used found that effects on brain cholinesterase occurred consistently between 1 and 3 mg/kg bw/day regardless of the oral route used.

1.4 Comment on Toxicology Assessment—Model

A registrant supports the use of a physiologically based pharmacokinetic (PBPK) model for neonatal simulations to support their position.

PMRA Response
While Timchalk et al. (2002) do provide an interesting and novel model for neonatal simulations, it is not considered for inclusion in the risk assessment of chlorpyrifos due to a lack of validation. In addition, the non-validated PBPK model in question relies heavily upon assumptions of absorption, constants determined through in vitro experimentation and computer simulation, all of which have their own inherent limitations.

1.5 Comment on Toxicology Assessment—Endpoint

A registrant contends that brain cholinesterase is the appropriate endpoint for cholinesterase inhibition (rather than erythrocyte cholinesterase inhibition).

PMRA Response
The PMRA concurs with the outcome of the consultation held in 1998 by the Joint Committee on Pesticide Residues (JMPR), at which the interpretation of inhibition of acetylcholinesterase activity was re-examined. Following the consultation, the JMPR concluded that erythrocyte cholinesterase could be considered an adverse effect indicative of peripheral neurotoxicity in the absence of acetylcholinesterase activity in the peripheral target tissue. It is the policy of the PMRA that erythrocyte cholinesterase inhibition may be used as an indication of an adverse effect level up to a study duration of approximately four weeks. After this duration, the interpretation of erythrocyte cholinesterase inhibition is confounded by the aging of inhibited enzyme and low rate of resynthesis (dependant on production of new erythrocytes).

A registrant has provided a non-guideline six-week dietary study of acetylcholinesterase inhibition in dogs. In the study, cholinesterase inhibition was examined in four tissues as well as the brain and erythrocytes at low doses. In all tissues, cholinesterase inhibition was determined following necropsy at week six. Although the observations were often limited due to large standard deviations in tissue cholinesterase activity, results from the study indicated that the administration of chlorpyrifos may affect peripheral nerve tissue.

A registrant contends that the dog study indicates that peripheral tissues were not more sensitive to the anticholinesterase effects of chlorpyrifos. However, due to the lack of validated study protocols and the inability to relate tissue cholinesterase concentrations at six weeks with acute or developmental study exposure durations of two weeks, erythrocyte cholinesterase will continue to be used as an indicator of peripheral cholinesterase inhibition for the purposes of the chlorpyrifos assessment.

1.6 Comment on Toxicology Assessment—Study Selection

A registrant disputes the selection of the study and uncertainty factors for the occupational risk assessment.

PMRA Response
In the event that a DNT study represents a critical effect level, conditions may be present where the study may be used in the establishment of short-, intermediate- and long-term dermal occupational reference doses for women of child bearing ages. Inhibition of erythrocyte cholinesterase is considered as a surrogate indicator of peripheral neurotoxicity because the duration of exposure is less than four weeks. As the DNT study with chlorpyrifos presents lower effect levels than that observed in longer term studies, it is sound logic to use the lower shorter-term effect level for chronic durations because short-term effects are just as likely to be observed with long-term exposure. The registrant's arguments concerning the gavage dosing issue, the relevance of erythrocyte cholinesterase measurements and the observed sensitivity being accounted for within the 10-fold intraspecies factor have been addressed in other sections.

1.7 Comment on Toxicology Assessment—Human Data

A registrant contends that acute reference doses should be calculated from human data.

PMRA Response
In the risk assessment, the PMRA does not use toxicity studies in which humans are intentionally dosed with pesticides for the purpose of identifying a human NOAEL. Human studies of this nature that have been brought to our attention have been used solely in a supplementary manner to confirm that the animal model is an appropriate surrogate for assessment purposes.

1.8 Comment on Toxicology Assessment—Additional Safety Factors

A registrant contends that the reference doses for women of childbearing age do not need an additional safety factor because the 3-fold difference in NOAELs between pregnant versus non-pregnant animals was plausibly attributed to gavage altered kinetics and within the already applied intraspecies uncertainty factor of 10-fold.

PMRA Response
Pregnant dams may be more sensitive than other adult animals to both the erythrocyte and brain cholinesterase inhibition effects of chlorpyrifos. Comparison of a developmental neurotoxicity study and a four-week cognitive study in rats in which chlorpyrifos was administered via oral gavage in both studies provides some support of this view, although the comparison is complicated by other factors such as different strains tested. It is worth noting that if pregnant dams are conclusively shown to be equally as sensitive as other adult animals, this could result in the lowering of reference doses for the general population to match those established for females 13+.

In identifying this potential sensitivity of pregnant dams, it is necessary to ensure that reference doses are sufficiently protective of the corresponding human subpopulation. The acute reference dose and acceptable daily intake established for the general population provides an insufficient margin of safety of 30 to a lowest observed adverse effect level (LOAEL) of 0.3 mg/kg bw/day (based on inhibition of erythrocyte cholinesterase at this level) in pregnant rats in the developmental neurotoxicity study. As per standard PMRA practice, an additional uncertainty factor of 3-fold was applied beyond the traditional 100-fold uncertainty factor to account for the lack of an identified NOAEL in this study.

The intraspecies uncertainty factor exists to account for variation existing within a population in the absence of known sensitive subpopulations. Studies indicate that activity levels of both paraoxanase and carboxylesterase in human individuals may exceed a 10× variability within the population. As oxonase and carboxylesterase activity have each been associated with the detoxification of chlorpyrifos, solely using a 10-fold safety factor for the general population may require additional consideration when the mechanisms of chlorpyrifos are fully elucidated.

Although this potential sensitivity was noted in a repeat-dose study, the absence of cholinesterase data in pregnant animals receiving a single dose necessitates the same consideration of potential sensitivity in females 13+ for the acute reference dose to be protective.

1.9 Comment on Toxicology Assessment—Hazard Classification

A registrant disputes the hazard classification of chlorpyrifos.

PMRA Response
There has not been an error made in PACR2003-03 with regards to the acute toxicity of chlorpyrifos. While a lethal dose 50% (LD_{50}) of 50–200 mg/kg bw does correspond to "moderately hazardous" under the World Health Organization classification scheme, the PMRA considers an LD_{50} of less than 500 mg/kg bw to be highly toxic.

1.10 Comment on Toxicology Assessment—Relevant Literature

A registrant contends that some of the literature is not relevant to the chlorpyrifos risk assessment due to irrelevant doses, routes of administration and the use of dimethylsulfoxide (DMSO) as a vehicle.

PMRA Response
While it is preferable to use studies in which the route of exposure is the same as that for the target population, studies using different routes of delivery can be very insightful and should be considered where applicable. As in the case of chlorpyrifos, when various studies that illustrate potential risk to the human population are available, it would not be conservative or good science to completely ignore all less than ideal sources of data.

Concern was raised by a registrant over the use of DMSO as a vehicle in some of the published studies. DMSO is a common vehicle for animal studies and is not expected to significantly confound study results when used with sham controlled animals.

The studies in question were not used to establish reference doses, but rather to reinforce concern for pup sensitivity. Quantitative data were not used from these studies, and the PMRA continues to consider this evidence insightful, though supplementary.

1.11 Comment on Occupational Risk Assessment—Mixer/Loader/Applicator

The review based mixer/loader/applicator exposure on the maximum label application rate and a high-end estimate of the area of crop that can reasonably be treated in a day. Because the document does not divulge the high-end estimate of the area that can be treated, the estimate may not take into account that most of the insecticides are only applied in the early morning from about sunrise to 10 a.m. or in the evening from 4 p.m. to sunset. Very little insecticide is applied from 10 a.m. to 4 p.m., unless it is cool, cloudy and wind velocities are light.

PMRA Response
The PMRA considers actual agronomic practices to determine area treated per day, or it harmonizes with the corresponding United States Environmental Protection Agency (USEPA) assessment if other data are not available. As much as possible, realistic values equal to or greater than the median value from surveys of agronomic practices are used. A value for the area treated per day is selected on the basis of the number of hours worked and the hourly coverage rate, regardless of the time of day application can occur.

1.12 Comment on Occupational Risk Assessment—Mixer/Loader/Applicator

The only indication of a pesticide's toxicity is the labelling on the outside of the formulated product's container. It would be helpful to the producer/applicator when making the appropriate decisions about how much protective equipment to wear if the label showed how toxic the product is when it is diluted at the recommended concentrations.

PMRA Response
The product label contains recommendations regarding PPE that are based on the outcome of risk assessments conducted for typical scenarios of mixing, loading and applying when products are used in accordance with label directions. The label recommendations regarding PPE account for dilution of product when used in accordance with label directions.

1.13 Comment on Proposed Regulatory Actions Relating to Dietary Risk—Plantback Restrictions

The thirty-day plantback restriction is not realistic for crops such as radishes, Chinese cabbages, pak choi and cole crops.

PMRA Response
Existing data indicate that immediate plant back of radish, Chinese cabbage, pak choi and cole crops is not likely to result in measurable residues. Therefore, no plantback restriction is required for these crops.

1.14 Comment on Proposed Regulatory Actions Relating to Dietary Risk—MRL for Potatoes

The MRL established for potatoes needs to consider the potential use in controlling wireworms.

PMRA Response
As indicated in DIS2006-01, Revocation of 0.1 ppm as a General Maximum Residue Limit for Food Pesticide Residues [Regulation B.15.002(1)], the Agency proposes to revoke 0.1 ppm as a general Maximum Residue Limit, and to replace it with specific MRLs for pesticide/food combinations. The proposal will include approaches that will enable ongoing MRLs to be established.

1.15 Comment on Proposed Regulatory Actions Relating to Dietary Risk—New Data and MRLs

The technical registrant requests that the PMRA review the submitted crop residue data to ensure that any new MRL that is established take full advantage of USEPA reviews. This will allow both agencies to set the same tolerances/MRLs and avoid trade-related issues. It also expects the PMRA to consult the JMPR reviews for chlorpyrifos and consider the CODEX MRLs when establishing MRLs for Canada, as well as take into account the outcome from the consultation on the *NAFTA Guidance Document on Data Requirements for Tolerances on Imported Commodities in the United States and Canada*.

PMRA Response
All available data will be considered in establishing MRLs. Where a registrant petitions the PMRA for an import MRL by submitting appropriate data, import MRLs will be established based on the supporting data, taking into consideration the established tolerances and MRLs of foreign jurisdictions to minimize the impact on trade.

1.16 Comment on Proposed Regulatory Actions Relating to Dietary Risk—MRL for Canola

The technical registrant submitted crop residue studies conducted on canola in Western Canada and proposes that the current default level of 0.1 ppm under Subsection B.15.002(1) of the Food and Drug Regulations be adopted as the MRL for chlorpyrifos on canola.

PMRA Response
The PMRA will review these data to establish an MRL for chlorpyrifos on canola.

1.17 Comment on Proposed Regulatory Actions Relating to Dietary Risk—Risk Cup

Both kiwifruit and citrus fruit have 100-fold higher tolerances compared to domestic crop uses, thus using up the risk cup. This preferential treatment is not given to Canadian uses in the American tolerance setting process.

PMRA Response
The MRL/tolerance is the highest residue at the farm gate, obtained by following label instructions for application timing and rates according to good agricultural practice, respecting the stated preharvest intervals. Maximum residue limits are established on imported commodities when the commodities are not grown in Canada or when a pesticide is not registered for a given crop in Canada, based on supervised field trials conducted at the maximum label rates. MRLs are not awarded on any type of merit; therefore, they are not subject to "preferential treatment". In some instances where use patterns differ and foreign tolerances are higher, the PMRA will establish an import MRL higher than the corresponding domestic MRL to avoid trade irritants, but this is only done with supporting field trial data and acceptable dietary risk. The dietary "risk cup", representing the sum of exposures from all food sources, is filled by residues on foods consumed that arise from proper pesticide use; if applicable, it allows for residue dissipation after harvesting and processing. A higher MRL does not necessarily result in a higher residue value in a refined dietary exposure and risk assessment.

2.0 Environmental Assessment

2.1 Comments on Spray Buffer Zones

Comments were received on several aspects of the spray buffer zones. Many of the responses regarding buffer zones indicated the interested parties felt that the buffer zones were too large and/or impractical. These comments included the following.

- The wider buffer zones required in Canada place growers at a disadvantage relative to their American counterparts.
- The proposed buffer zones are too wide, unrealistic and difficult to enforce.
- It is not appropriate to require mitigation measures based on conservative, lower tier assessments.
- The re-evaluation should address the issue of aerial application and the presence of prairie potholes. Extremely wide buffer zones effectively remove chlorpyrifos as an option if this part of the label was strictly followed.

PMRA Response

The mandate of the PMRA is to protect human health and the environment. Spray buffer zones are a mitigation measure required when drift from pesticide sprayed applications will result in exposure concentrations in non-target areas that exceed effects thresholds for non-target organisms. The alternative to the requirement for in-field mitigation measures, such a spray buffer zones, is to cancel registrations for uses that would result in unacceptable environmental effects.

For the past few years, the PMRA has used a science-based approach to determine spray buffer zones for all new products registered. This approach uses empirical models that determine the proportion of drift/deposition that results in off-field exposure concentrations at which no unacceptable effects occur. The current approach uses the no observed effect concentration (NOEC) from the most sensitive non-target organism as the acceptable environmental exposure concentration. For estimating aquatic concentrations resulting from spray drift, a standardized water depth of 30 cm is used. With this approach, the magnitude of the buffer zones reflects both the toxicity of the product to non-target organisms and the major application factors that affect off-target deposition such as type of spray equipment, setup of equipment and rate of application.

In the re-evaluation of chlorpyrifos, the calculation of buffer zones as described above was refined by the use of additional available information on toxicity and parameters on pesticide application. Based on a large database on aquatic toxicity for chlorpyrifos, including a number of mesocosm studies, the PMRA chose to use an effects level endpoint for aquatic invertebrate communities, rather than the NOEC for the most sensitive species, as the effects threshold level. Additionally, buffer zones were determined for several water depths to account for the variability in depth of aquatic ecosystems. For aerial buffer zones, information from aerial applicators on nozzle set-up parameters for applications of chlorpyrifos was used as model input to characterize drift, from which buffer zones for aerial applications were determined.

The PMRA currently uses the AGDISP Model (version 8.08) for estimating the buffer zones required to mitigate the potential environmental impacts of spray drift resulting from the aerial application of pesticides. The PMRA has conducted a preliminary assessment of the AGDISP simulation of spray drift. Until a more comprehensive assessment of the AGDISP output is completed and a refined risk assessment is completed, an interim approach is being used. In this case where the calculated aerial buffer zones are in excess of 100 metres, the PMRA will limit the maximum buffer zone to 100 metres.

Additionally, the PMRA recognizes that spray drift can be reduced for field sprayers through the use of drift reducing devices such as shrouds and cones. When using shrouds or cones on field sprayers, buffer zones can be reduced by 70% and 30%, respectively .

The PMRA is currently in the process of refining some of the underlying models and policies used in buffer zone determinations as well as refining selection of endpoints used in risk assessment. Therefore, the buffer zones are interim and will be reassessed when the refined environmental risk assessment is under taken.

While the buffer zones for chlorpyrifos are large, it is important to note the following points when interpreting when and how to apply spray buffer zones.

- Buffer zones are only required when the sensitive area is down wind of the spray.
- Buffer zones need only be observed when spraying adjacently to sensitive areas.
- Buffer zones are measured from the edge of the downwind side of the spray swath to the nearest edge of the identified sensitive area.

2.2 Comments on Level/Comprehensiveness of Risk Assessment

Comments were received from several parties on the suitability of current risk assessment methods and the data used to conduct the risk assessment. These comments included the following.

- Using the Tier 1 risk assessment model is too simplistic.
- The assumption that the maximum rate is used and application always occurs twice per season is unrealistic.
- There are no reports of significant damage to aquatic invertebrates and fish in Western Canada.
- A tiered approach was not followed in ecological risk assessment. Higher-level refinements are possible due to available data and refined approaches of estimating risk should be used before final decisions are made. The current assessment overestimates both exposure and risk.
- Conduct higher tiered assessment consistent with the methodologies used by other major regulatory agencies.
- Use numerous published and company field studies for a weight-of-evidence approach to risk assessment. Use of avian risk quotients for organophosphates typically underestimates risk due to food avoidance in dietary toxicity tests. Use numerous published reports on interspecies sensitivity differences in acute toxicity test to adapt risk to passerine species. Take better account of dermal toxicity. Risk assessment needs to consider effects on amphibians; published data show that chlorpyrifos is toxic to larval amphibians.
- A good environmental assessment should use all sources of data; the use of Tier 1 risk assessments and simplistic models is unacceptable.
- When and how the Tier 2 assessment will be used is not defined in the document.
- While the PMRA agrees that chlorpyrifos is highly toxic to birds, registrations that result in the highest levels of avian exposure are being maintained.
- The data source for effects on non-target organisms is not identified; the technical registrant has conducted detailed studies on concentration of chlorpyrifos on birds and mammals in agricultural areas that the PMRA should re-examine.

PMRA Response

In PACR2003-03, the PMRA stated its intent to refine the environmental risk assessment. During the refined assessment, the PMRA will address additional information on effects and/or exposure using more sophisticated methods.

The PMRA targets completion of a refined environmental assessment of chlorpyrifos by the end of 2008.

2.3 Comments on Effects of Chlorpyrifos on Amphibians

Risk assessments need to consider effects on amphibians because of declining populations and because they occupy/share aquatic environments. Published data show that chlorpyrifos is toxic to larval amphibians.

PMRA Response
While there was consideration of toxicity to amphibians in the full risk assessment (not detailed in the PACR), the hazard to amphibians was not specifically identified because amphibians were not among the most sensitive organisms. We recognize the sensitivity of aquatic organisms and measures to protect the sensitive aquatic species, such as buffer zones, will result in protection of less sensitive organisms. For reference, the most sensitive endpoint identified for amphibians was 10 times less sensitive than the endpoint based on results of mesocosm experiments used in buffer zone determinations.

2.4 Comments on Mitigation for Potential Effects on Bees

Comments were received on the proposed label statements to protect non-target pollinators.

- Chlorpyrifos is toxic to bees on direct contact. The following label statement should be added: "Avoid applying this product to a crop in bloom to prevent pollinator mortality due to drift or direct contact." The responsibility of informing beekeepers of sprays should not rest with applicator; investigate more effective methods of communication.
- Toxicity to bees is mitigated by application at or beyond petal drop stage, in the evening or late in the season.

PMRA Response
Mitigation of effects on non-target pollinators is difficult to achieve. The PMRA will continue to work with provincial apiarists, bee keepers and user communities to develop effective mitigation methods and strategies. Standardized label statements have been included (see Appendix II).

2.5 Comments on Concentrations in Drinking Water—Request for Monitoring Data

The PMRA had requested monitoring of drinking water be conducted. A registrant provided American data on surface water monitoring as well as commented that these data are representative of Canadian conditions and should be used by the PMRA.

PMRA Response
In response to the PMRA request, a registrant submitted a study conducted in the United States that reported concentrations for several pesticides, including chlorpyrifos, for finished water. This study was determined to be of limited value for our assessment as the concentrations were measured in finished water rather than raw water. However, other information submitted by the registrant indicated Canadian data were available for surface water.

In addition, at the time of the initial assessment of chlorpyrifos, a standardized approach for determining potential drinking water concentrations was in development, but not yet available for inclusion in the risk assessment. In the intervening time, the approach was finalized. This new approach allows consideration of both a modelling approach and the use of monitoring data. The results of water modelling for surface and ground water as well as an analysis of available monitoring data have now been completed and have been considered in the final decision.

Estimated levels of drinking water residues present over prolonged periods of time (i.e., leading to chronic exposure) are not a health concern for chlorpyrifos. Acute drinking water levels of comparison fall between the lower and upper bound estimates defined by available monitoring data and model estimates, respectively. Model estimates for areas where cole crops are grown indicate that acute drinking water concentrations may be of concern. There is uncertainty in the monitoring data used as the lower bound of drinking water concentrations: samples may not have been collected from areas where chlorpyrifos is used and they may not have been collected at a time likely to capture the maximum concentration of chlorpyrifos. Therefore, further drinking water monitoring data are required, especially from areas where wheat or cole crops are grown, with concomitant chlorpyrifos use information from the areas surrounding sample collection.

2.6 Comments on Use of Chlorpyrifos for Grasshopper Control

Concern has been expressed that use for grasshopper control may have serious impacts on birds, and in particular may impact burrowing owls, a Schedule 1 endangered species. Concern was also expressed that the scale of use will lead to effects over a wide area. It was noted that aerial applications to control grasshoppers are proposed for deletion, but that aerial applications were allowed for other pests in the same or similar crops with rates greater or equal to those for grasshopper control.

PMRA Response

The decision regarding the retention of aerial applications reflected a number of considerations that were not described in the original PACR. Based on the initial environmental assessment, the PMRA has concerns regarding the environmental risks associated with chlorpyrifos and the potential effects on non-target aquatic and terrestrial organisms. Although spray buffer zones can mitigate the exposure of aquatic organisms from spray drift, options for mitigating exposures from runoff are more difficult. Potential effects on terrestrial organisms (e.g., birds) are also difficult to mitigate due to the occurrence of non-target species in treated areas. Mitigation is particularly difficult with regards to aerial applications, which, in the case of chlorpyrifos, can involve treatment of large areas (e.g., for control of pests on canola and cereals across Canada or grasshopper control in Western Canada).

Given these concerns, the PMRA adopted a strategy to limit environmental exposures by limiting use and types of application methods. This approach resulted in the proposed deletion of aerial applications for grasshopper control, as a number of alternatives are available for aerial application. The Agency has decided to undertake further consultations (see Section 2.5.3) on aerial use. However, buffer zones will be required.

2.7 Comments on Mosquitocide Uses of Chlorpyrifos

Some respondents expressed concerns over the use of chlorpyrifos as a mosquito adulticide. They were of the view that using chlorpyrifos to control adult mosquitoes should be prohibited immediately, given the amount of chlorpyrifos that may be used to control adult mosquitoes as a result of West Nile virus concerns, the toxic nature of chlorpyrifos and the resulting low efficacy of adulticiding.

PMRA Response
In the first phase of the re-evaluation of chlorpyrifos, the registration for using chlorpyrifos to control adult mosquitoes (ground application only) was maintained. Although not currently used anywhere in Canada for this purpose, registration of this use of chlorpyrifos will be maintained, in case of a public health concern such as an outbreak of West Nile virus. It will also be a Restricted class use requiring provincial authorization. It is only to be used after consultation with federal, provincial and territorial regulatory authorities to address public health concerns.

3.0 Phase 2 Label Amendments

3.1 Comments on a Definition

Clarification was requested regarding the definition of "outlying areas" for the mosquito larvicide use in Appendix I of PACR2003-03.

PMRA Response
As an outcome of the Phase 1 re-evaluation, mosquito larvicide use for chlorpyrifos has been restricted to the treatment of temporary pools (e.g., shallow, grassy depressions; flooded woodlands; industrial parks; roadway ditches; railway marshalling yards; small temporary sloughs). The product cannot be applied to permanent water bodies such as lakes, dugouts or fish ponds. It also cannot be applied in areas where there may be potential exposure to bystanders. In addition, the product should be applied at an appropriate distance (to be established by the municipality or province) from residences, hospitals, schools, parks, playing fields and playgrounds.

3.2 Comments on Integrated Pest Management in Controlling Mosquitoes

Clarification was requested regarding the role of integrated pest management in controlling mosquitoes.

PMRA Response
Integrated pest management in terms of mosquito control means that decisions to control mosquitoes are based on surveillance. Several tactics can be used to reduce mosquito populations to acceptable levels, such as water management (e.g., reducing sources of standing water, where practical) and, if systematic monitoring of pest populations indicates a need, the application of larvicides. Controlling the immature stages before mosquitoes emerge as adults can reduce the need for widespread application of mosquito adulticides at a later date. Adulticiding is only to be used when warranted, often when source reduction and larviciding measures have not achieved an adequate level of control. Decisions on when to treat for mosquitoes, and which control products to use, are made at the local or provincial level.

3.3 Comments on the Use on Elm Trees

Clarification is required as to whether chlorpyrifos is permitted for use on elm trees in residential areas (boulevards, parks, playgrounds and schools) to control Dutch elm beetle.

PMRA Response
As part of the Phase 1 re-evaluation decision, registration of chlopyrifos was maintained for the treatment of elm trees to control elm bark beetle, the carrier of the causal fungus of Dutch elm disease. As a result of that decision, the application rate was reduced by 80% and the application was limited to the lower 50 cm of the tree trunk rather than treating the entire tree. Chlorpyrifos is applied primarily in Prairie towns and cities under the authorization of the provinces, where the American elm is the principal shade tree. Treatment of elm trees along boulevards and in parks, playgrounds, etc., is permitted under this restricted use pattern.

4.0 Use Standard (Appendix IV of PACR2003-03)

4.1 Comment on the Precautions

The PMRA should rethink the requirement that applicators using closed cabs should wear chemical-resistant gloves. It may be more effective to tell applicators to remove gloves before entering the enclosed cab or handling the steering wheel. The section on ground equipment with a closed cab says this, but the section on airblast equipment requires gloves. Both sections should read the same.

PMRA Response
Labels should indicate that applicators using airblast equipment with a closed cab must wear chemical-resistant gloves when leaving the cab for cleanup and repairs. Applicators using ground application equipment and airblast sprayers with closed cabs must remove gloves before entering the cab to avoid contaminating the cab.

4.2 Comment on the Precautions

Specifying the applicator must wear socks is very condescending and should be removed as it will not achieve the desired result. Instead, use the wording: "Wear chemical-resistant footwear". Either require chemical-resistant footwear or do not refer to footwear at all.

PMRA Response
The Worker Protection Standard from the United States includes socks in the description of PPE. As it is expressly spelled out that socks must be worn with chemical-resistant footwear, remaining silent on the matter in other instances would imply that socks are not required. The explicit statement that socks must be worn avoids any ambiguity created by merely assuming that all pesticide handlers wear socks.

4.3 Comments on the Precautions

The agricultural industry in British Columbia is not currently able to implement the requirement for closed mechanical transfer loading systems for chlorpyrifos containers less than or equal to 10 L.

PMRA Response
The requirement for closed mechanical transfer loading systems applies to chlorpyrifos containers of more than 10 L.

4.4 Comments on the Precautions

Most pesticide applications in British Columbia are not carried out in closed cabs. It is not currently practical or feasible to require applicators to convert to closed cabs. Converting equipment to closed cabs is very costly, and there are other legal requirements and implications that would need to be considered.

PMRA Response
The PMRA recognizes that the requirement for closed cabs may be unrealistic in terms of additional expense and greater space needed between established orchard rows, for example. The PPE that applicators must wear if not in fully enclosed cabs is presented in Appendix II.

4.5 Comments on the Precautions

The "Applicators using handheld equipment" section says that they must wear "chemical-resistant footwear and shoes". Please correct this error as people cannot wear two pairs of footwear.

PMRA Response
The statement on footwear for applicators using handheld equipment should read "chemical-resistant footwear and socks".

4.6 Comments on the Precautions

Consider changing the term "ground equipment" as airblast applicators are a type of ground equipment. Boom sprayers may be a more appropriate term.

PMRA Response
The term "ground equipment" was intended to identify equipment used to apply products downward, but not exclusively to the ground itself. Recognizing that airblast sprayers are generally ground based, the term was not meant to be the opposite of aerial equipment. As granular spreaders are also ground based but are not boom sprayers, the term should read "ground application equipment".

4.7 Comments on the Precautions

Consider adding a note for wettable powder formulations: "Do not break open water-soluble packages".

PMRA Response
This statement is acceptable for wettable powder formulations.

Appendix II Use Standard for Agricultural Uses of Products Containing Chlorpyrifos

NOTE: The information in this appendix summarizes the allowable uses, limitations and minimum PPE for the agricultural uses of products containing chlorpyrifos, resulting from this re-evaluation. This use standard does not identify all label requirements for individual end use products such as first aid statements, disposal statements, detailed directions for use, precautionary statements and supplementary PPE that may be required. Additional information on labels for currently registered products should not be removed unless it contradicts information in this use standard.

COMMON NAME: chlorpyrifos

CHEMICAL NAME: *O,O*-diethyl *O*-(3,5,6-trichloropyridin-2-yl) phosphorothioate

FORMULATION TYPES:

EC	emulsifiable concentrate
GR	granular
WP	wettable powder

USE-SITE CATEGORY: Terrestrial Food Crops 14

TOXICOLOGICAL INFORMATION

Chlorpyrifos is an organophosphate that is a cholinesterase inhibitor. Typical symptoms of overexposure to cholinesterase inhibitors include headache, nausea, dizziness, sweating, salivation, runny nose and eyes. This may progress to muscle twitching, weakness and tremor incoordination, vomiting, abdominal cramps and diarrhea in more serious poisonings. A life-threatening poisoning is signified by loss of consciousness, incontinence, convulsions and respiratory depression with a secondary cardiovascular component. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate degree of exposure (baseline data are useful). Atropine, only by injection, is the preferable antidote. Oximes, such as pralidoxime chloride, may be therapeutic if used early; however, use only in conjunction with atropine. In cases of severe acute poisoning, use antidotes immediately after establishing an open airway and respiration. With oral exposure, the decision of whether to induce vomiting or not should be made by an attending physician.

[For those products that contain greater than 10% petroleum distillates, the following text should also be added to **TOXICOLOGICAL INFORMATION** section (placed at the end of the paragraph presented above), as an additional aid to the attending physician:

NOTE: Product contains a petroleum distillate solvent.]

PRECAUTIONS FOR MIXERS/LOADERS

For EC formulations packaged in containers more than 10 L

Mixers/loaders must use a closed mechanical transfer loading system. Mixers/loaders must wear:

- coveralls over a long sleeved shirt and long pants
- chemical-resistant gloves
- an air purifying respirator with an -R or -P series filter
- socks and shoes

For EC formulations packaged in containers holding 10 L or less

Mixers/loaders must wear:

- coveralls over a long-sleeved shirt and long pants
- chemical-resistant gloves
- a chemical-resistant apron
- chemical-resistant footwear plus socks
- an air purifying respirator equipped with an -R or -P series filter

For WP formulations (must be packaged in water-soluble bags)

Mixers/loaders must wear:

- a long-sleeved shirt and long pants
- socks and shoes
- chemical-resistant gloves
- chemical-resistant apron

Mixers and loaders using water-soluble packets must have immediately available for use in emergency (such as a broken package, spill or equipment breakdown) additional PPE. These PPE include coveralls and chemical-resistant footwear and a non-powered air purifying respirator equipped with an -R or -P series filter.

For GR formulations

Mixers/loaders must wear:

- coveralls over a long-sleeved shirt and long pants
- chemical-resistant gloves
- chemical-resistant footwear and socks
- an air purifying respirator equipped with an -R or -P series filter
- chemical-resistant apron

PRECAUTIONS FOR APPLICATORS

Do not apply with high-pressure handwand equipment.

Applicators using airblast equipment with a closed cab must wear:

- a long-sleeved shirt and long pants
- socks and shoes
- chemical-resistant gloves when leaving cab for clean-up and repair (gloves must be removed and left outside when re-entering the cab)

Applicators using airblast equipment with an open cab must wear:

- a long-sleeved shirt and long pants
- chemical-resistant coveralls and head protection
- socks and shoes
- chemical-resistant gloves
- an air purifying respirator with an -R or -P series filter

Applicators using ground application equipment with a closed cab must wear:

- a long-sleeved shirt and long pants
- chemical-resistant gloves when leaving cab for clean up and repair (gloves must be removed when re-entering the cab)
- socks and shoes

Applicators using ground application equipment with an open cab must wear:

- coveralls over a long-sleeved shirt and long pants
- chemical-resistant gloves
- socks and shoes

Applicators using aerial application equipment must use enclosed cockpits and must wear:

- a long-sleeved shirt and long pants
- socks and shoes

Applicators using handheld equipment must wear:

- a long-sleeved shirt and long pants
- chemical-resistant coveralls and head protection (if spray is upwardly directed)
- chemical-resistant footwear and socks
- chemical-resistant gloves
- an air purifying respirator with an -R or -P series filter

ENVIRONMENTAL PRECAUTIONS

HAZARDS

The following statements must be included in the **ENVIRONMENTAL HAZARDS** section of the label.

TOXIC to birds.

TOXIC to birds. Any spilled or exposed granules must be incorporated into the soil or otherwise cleaned-up from the soil surface.

TOXIC to wild mammals.

TOXIC to wild mammals. Any spilled or exposed granules must be incorporated into the soil or otherwise cleaned-up from the soil surface.

TOXIC to bees exposed to direct treatment, drift, or residues on blooming plants. Do not use on flowering crops or weeds.

TOXIC to certain beneficial insects. Minimize spray drift to reduce harmful effects on beneficial insects in habitats next to the application site such as hedgerows and woodland

DO NOT apply this product or allow it to drift to flowering crops or weeds if bees are visiting the treatment area. Applicators should inform local bee keepers prior to application if hives are in adjacent fields. Minimize spray drift to reduce harmful effects on bees in habitats close to the application site.

To reduce runoff from treated areas into aquatic habitats, consider the characteristics and conditions of the site before treatment. Site characteristics and conditions that may lead to runoff include, but are not limited to, heavy rainfall, moderate to steep slope, bare soil, poorly draining soil (e.g., soils that are compacted or fine textured such as clay).

Avoid application of this product when heavy rain is forecast.

Contamination of aquatic areas as a result of runoff may be reduced by including a vegetative strip (buffer zone) between the treated area and the edge of the water body.

Buffer Zones for Protection of Aquatic Habitats

The following statements and information are to appear under the **DIRECTIONS FOR USE** section of labels of wettable powder and emulsifiable concentrate products to be used on agricultural crops, where relevant. The buffer zones identified below do not apply to uses of granular formulations of chlorpyrifos.

For all applications: DO NOT apply during periods of dead calm. Avoid application of this product when winds are gusty.

For aerial applications: DO NOT apply when wind speed is greater than 16 km/h at flying height at the site of application. The nozzle type is restricted to CP®, with the following set-up restriction:

Nozzle Type	Restriction
CP®	**DO NOT** use greater than 30° deflection

For airblast applications: Airblast applications are only permitted on peaches and nectarines. **DO NOT** direct spray above plants to be treated. Turn off outward pointing nozzles at row ends and outer rows. **DO NOT** apply when wind speed is greater than 16 km/h at the application site as measured outside of the treatment area on the upwind side.

Buffer Zones

The buffer zones specified in the following tables are required between the point of direct application and the closest downwind edge of sensitive freshwater habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands), estuarine habitats and marine habitats.

Aerial Applications

For all aerial applications, a buffer zone of 100 metres is required for the protection of aquatic habitats.

Field Sprayer Applications [1, 2]

Rate of Application (g a.i./ha)	Buffer Zones (metres) Required for the Protection of Aquatic Habitats With Water Depths Of:		
	< 1 metre	1–3 metre	> 3 metre
Up to 576	50	40	30
Greater than 576, and less than or equal to 1152	55	45	35
Greater than 1152 and up to 2304	60	50	40

1 For field sprayer application, buffer zones can be reduced with the use of drift reducing spray shields. When using a spray boom fitted with a full shield (shroud, curtain) that extends to the crop canopy or ground, the labelled buffer zone can be reduced by 70%. When using a spray boom where individual nozzles are fitted with cone-shaped shields that are no more than 30 cm above the crop canopy or ground, the labelled buffer zone can be reduced by 30%.

2 Buffer zones are not required for treatments applied as a drench (i.e., drench applications for control of cabbage maggot, onion maggot and seedcorn maggot).

Airblast Applications

Rate of Application (g a.i./ha)	Buffer Zones (metres) Required for the Protection of Aquatic Habitats With Water Depths Of:		
	< 1 metre	1–3 metre	> 3 metre
Up to 1725	80	70	55

DIRECTIONS FOR USE

The following statements are required for all **broadcast pesticide products**, except for those applied directly to water.

DO NOT apply this product directly to aquatic habitats (such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs, ditches and wetlands), estuaries habitats or marine habitats.

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

Application by aircraft is permitted only where specified in the directions for use.

A plantback interval of 30 days must be observed between application and planting of rotational crops, with the exception of radish, Chinese cabbage, pak choi and cole crops for which no plantback restriction is required.

Sites and Pests	Rates and Directions
CANOLA	**EC formulation:** Do not apply more than once per season. Do not apply within 21 days of harvest. Application is permitted by ground application equipment or aircraft where specified. Do not enter treated fields until 1 day after application.
Bertha armyworm, alfalfa looper, armyworm	**EC formulation:** Apply 360–480 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply as a foliar spray. Use the higher rate of dilution when infestations are heavy and when the foliage is dense. Spray in the evening to reduce harm to pollinators.
Diamondback moth (larvae)	**EC formulation:** Apply 480–720 g a.i. in 100–200 L/ha for ground application equipment, or in 40 L/ha for aircraft. Apply as a foliar spray. Use the higher rate of dilution when infestations are heavy and when the foliage is dense. Spray in the evening to reduce harm to pollinators.
Lygus bugs	**EC formulation:** Apply 240–480 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply as a foliar spray. Use the higher rate of dilution when infestations are heavy and when the foliage is dense. Spray in the evening to reduce harm to pollinators.
Army cutworm, darksided cutworm, pale western cutworm, redbacked cutworm, variegated cutworm	**EC formulation:** Apply 420–576 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply to the soil or foliage. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm.
Grasshoppers	**EC formulation:** Apply 278–420 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply as a foliar spray. Use the low rate for the control of juvenile grasshoppers and the high rate for the control of adult grasshoppers. Adjacent ungrazed and unoccupied areas such as roadsides, rights-of-way and fence lines should be treated at the first sign of infestation.
FLAX	**EC formulation:** Do not apply more than once per season. Do not apply within 21 days of harvest. Application is permitted by ground application equipment or aircraft where specified. Do not enter treated fields until 1 day after application.
Bertha armyworm	**EC formulation:** Apply 360–480 g a.i. in 50–200 L/ha for ground application equipment and 10–30 L/ha for aircraft. Apply as a foliar spray. Use the higher rate for larger larvae or when foliage is dense.

Sites and Pests	Rates and Directions
Army cutworm, darksided cutworm, pale western cutworm, redbacked cutworm, variegated cutworm, armyworm	**EC formulation:** Apply 420–576 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply to the soil or foliage.
LENTIL	**EC formulation:** Application is permitted by ground application equipment or aircraft where specified. Do not apply more than once per season. Do not apply within 21 days of harvest for applications up to 420 g a.i./ha. For application greater than 420 g a.i./ha, do not apply within 60 days of harvest. Do not enter treated fields until 1 day after application.
Pale western cutworm	**EC formulation:** Apply 420–576 g a.i. in 100–200 L/ha for ground application equipment, or in 20 L/ha for aircraft. Apply as a broadcast spray when damage first appears.
Grasshoppers	**EC formulation:** Apply 278–576 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply once per year at the flowering to early podding stage of crop. Uniform coverage of the crop and the crop canopy is essential. Use the low rate for the control of juvenile grasshoppers and the high rate for the control of adult grasshoppers. Adjacent ungrazed and unoccupied areas such as roadsides, right-of-ways and fence lines should be treated at the first sign of infestation.
CORN (FIELD, SWEET)	**EC, WP, GR formulations:** Do not apply more than 1 application per season. Do not apply within 70 days of harvest. Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application.
Northern corn rootworm, western corn rootworm, cutworm (suppression)	ROW TREATMENT **GR formulation:** Apply 11.25 g a.i. per 100 m row. Incorporate the granules into the top 2.5 cm of soil by placing a 15–18 cm wide band over the row behind the planter shoe and ahead of the press wheels. When applied as directed for rootworm control, this product will provide some reduction of cutworm populations. However, under heavier infestations of cutworms, further insecticidal treatment with other formulations may be necessary.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT (PREPLANTING) **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once as a soil treatment 3–7 days before planting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC and WP formulations:** Apply 562–1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray at the 2- to 5-leaf stage of the crop.
CORN (SEED)	**GR formulation:** Do not apply more than 1 applications per season. Do not apply within 70 days of harvest. Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application.

Sites and Pests	Rates and Directions
Northern corn rootworm, western corn rootworm, cutworm (suppression)	ROW TREATMENT **GR formulation:** Apply 11.25 g a.i. per 100 m row. Incorporate the granules into the top 2.5 cm of soil by placing a 15–18 cm wide band over the row behind the planter shoe and ahead of the press wheels. When applied as directed for rootworm control, this product will provide some reduction of cutworm populations. However, under heavier infestations of cutworms, further insecticidal treatment with other formulations may be necessary.
PEACH, NECTARINE	**WP formulation:** Do not apply more than twice per season. Do not apply within 21 days of harvest. Ground application only (do not apply by aircraft). Do not enter treated fields until 4 days after application to conduct scouting activities.
Oriental fruit moth	**Restricted use** NATURE OF RESTRICTION: To be used only in the Oriental Fruit Moth Resistance Management Program in the Regional Municipality of Niagara and Essex County, coordinated by the Ontario Ministry of Agriculture and Food (OMAF). OMAF will provide growers with information/training; application training and pest management program advice. **WP formulation:** Apply 1725 g a.i. in 1000–2000 L water/ha. RESISTANCE MANAGEMENT: Best results will be obtained when application of this insecticide is timed for egg hatch or first instar larvae of first generation Oriental fruit moth, usually around shuck to shuck-split. Growers should consult a local OMAF pest management specialist for exact timing of applications. Make 1–2 applications as needed. Apply as ground application only using an airblast sprayer. Direct nozzles of air blast sprayer into the targeted peach or nectarine tree orchard when spraying border rows.
STRAWBERRY	**EC and WP formulations:** Do not apply more than once per season. Ground application only (do not apply by aircraft). Do not apply within 20 days of harvest. Do not enter treated fields until 1 day after application.
Strawberry cutworm (crown borer)	**EC and WP formulations:** Apply 562.5–576 g a.i. in 2000 L/ha. Apply once as a foliar spray between June 1 and June 15. Large volumes of water are desirable to ensure full wetting of the crown area of the plants.
ASIAN RADISH (LO BOK, DAIKON)	**EC formulation:** Do not apply more than 3 times per season. Ground application only (do not apply by aircraft). Do not apply within 32 days of harvest. Do not enter treated fields until 1 day after application.
Cabbage maggot	**EC formulation:** Apply 100.8 g a.i. in 1000 L of water per 1000 m row. Apply as a drench over seeded rows at 7, 20 and 35 days after seeding.
RADISH	**EC formulation:** Do not apply more than once per season. Ground application only (do not apply by aircraft). Do not apply within 21 days of harvest. Do not enter treated fields until 1 day after application.

Sites and Pests	Rates and Directions
Cabbage maggot	**EC formulation:** Apply 40.8 g a.i. in 380 L of water per 1000 m row. Apply as a drench with seed at planting time.
CELERY, CUCUMBER, PEPPER (GREEN)	**EC and WP formulations:** Do not apply more than once per season. Do not apply within 70 days of harvest for celery, 40 days of harvest for pepper, or 60 days of harvest for cucumber. Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once as a soil treatment 3–7 days before planting or transplanting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC and WP formulations:** Apply 562–1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray at the 2- to 5-leaf stage of the crop.
PAK CHOI, BROCCOLI, BRUSSELS SPROUT, CABBAGE, CAULIFLOWER, CHINESE CABBAGE	**GR, EC and WP formulations:** Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application for pak choi and Chinese cabbages. Do not enter treated fields until 10 days after application for cauliflower, 1 day after application for all other crops. [See also below.] **GR formulation:** Do not apply more than once per season. **EC formulation:** If no granular chlorpyrifos treatment has been used, do not apply more than twice per season to broccoli, cabbages, cauliflower, Chinese cabbages and pak choi, or three times per season to Brussels sprouts. If granular treatment has been used, do not apply more than once per season to broccoli, cabbages, cauliflower, Chinese cabbages and pak choi, or twice per season to Brussels sprouts. Do not apply within 32 days of harvest for broccoli, Brussels sprouts, cabbages, cauliflower or Chinese cabbages; or within 15 days of harvest for pak choi. **WP formulation:** Do not apply more than once per season. Do not apply within 32 days of harvest to cabbages.
Cabbage maggot (BROCCOLI, BRUSSELS SPROUT, CABBAGE, CAULIFLOWER only)	**GR formulation:** Apply 90–150 g a.i. per 1000 m of row. Apply as an in-furrow, at-plant treatment. Application rates for different row spacings are as follows: **Row Spacing** — **kg a.i./ha** 30 cm — 3–5 60 cm — 1.5–2.5 75 cm — 1.2–2 80 cm — 1.125–1.875 90 cm — 1–1.7 105 cm — 0.86–1.42

Sites and Pests	Rates and Directions
Cabbage maggot	**EC formulation:** AT-PLANTING TREATMENT: Apply 100.8 g a.i./1000 m row. Apply one drench spray in 1000 L/ha spray solution, 10 cm on each side of the plant, 7–10 days after seeding or 3 days after transplanting. POST PLANTING DRENCH: Mix 806 g a.i. in enough water to make 1000 L of finished spray. Apply 12.5 L of this solution per 100 m of row on soil, 10 cm on each side of the plant. Do not apply to harvestable portions of the crop. **If no granular treatment was used at seeding:** For broccoli, Brussels sprouts, cabbages and cauliflower, apply a drench treatment within 3 days of transplanting (after plant recovery) or 7–10 days after seeding. Repeat 21 days after the transplanting drench or 28 days after the seeding drench.
Cabbage maggot (CABBAGE only)	**WP formulation:** Apply 16.25 g a.i./100 L. TRANSPLANT WATER TREATMENT: Apply 200 mL of solution with each plant. Do not use starter fertilizers with this product.
Black cutworm, darksided cutworm, redbacked cutworm (for BROCCOLI, BRUSSEL SPROUTS, CABBAGE, CAULIFLOWER, CHINESE CABBAGE)	SOIL TREATMENT **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once, 3–7 days before transplanting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC and WP formulations:** Apply 562–1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray at the 2- to 5-leaf stage of the crop.
CHINESE BROCCOLI	**EC formulation:** Do not apply more than once per season. Ground application only (do not apply by aircraft). Do not apply within 21 days of harvest. Do not enter treated fields until 1 day after application.
Cabbage maggot	**EC formulation:** Apply 72 g a.i. in 800 L/1000 m row. Apply once per season banded over the row 5–7 days after seeding.
GARLIC	**EC formulation:** Do not apply more than twice per season. Do not apply within 50 days of harvest. Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application.
Onion maggot	**EC formulation:** Apply 1680 g a.i. in 1000 L/ha. Apply as a drench to the soil over the seedling row.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once, 3–7 days before transplanting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC formulation:** Apply 576–1152 g a.i. in 200–400 L/ha Apply once as a broadcast spray at the 2- to 5-leaf stage of the crop.

Sites and Pests	Rates and Directions
RUTABAGA	**GR, EC and WP formulations:** Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application. Do not apply within 30 days of harvest. [See also below.] **GR formulation:** Do not apply more than once per season. **EC formulation:** If no granular chlorpyrifos treatment has been used, do not apply more than 4 times per season. If granular chlorpyrifos treatment has been used, do not apply more than 3 times per season. **WP formulation:** Do not apply more than once per season.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once, 3–7 days before transplanting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC and WP formulations:** Apply 562–1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray at the 2- to 5-leaf stage of the crop.
Cabbage maggot	**GR formulation:** Apply 90–150 g a.i. per 1000 m of row. Apply as an in-furrow, at-plant treatment. Application rates for different row spacings are as follows: **Row Spacing** — **kg a.i./ha** 30 cm — 3–5 60 cm — 1.5–2.5 75 cm — 1.2–2 80 cm — 1.125–1.875 90 cm — 1–1.7 105 cm — 0.86–1.42
Cabbage maggot	**EC formulation:** Apply 100.8 g a.i. in 125 L/1000 m row. Apply as a postplanting drench to soil, 10 cm on each side of the plant. Application rates for different row spacings are as follows: **Row Spacing** — **kg a.i./ha** 30 cm — 3.36 60 cm — 1.68 75 cm — 1.34 80 cm — 1.26 90 cm — 1.12 105 cm — 0.96 Do not apply to harvestable portions of the crop. If no granular treatment was used at seeding, apply drench treatments at 10, 28, 49 and 70 days after seeding. If granular treatment with a chlorpyrifos insecticide was used at seeding, apply drench treatments at 28, 49 and 70 days after seeding.

Sites and Pests	Rates and Directions
CARROT	**EC and WP formulations:** Ground application only (do not apply by aircraft). Do not apply more than once per season. Do not apply within 60 days of harvest. Do not enter treated fields until 1 day after application.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152–2304 g a.i. in 200–400 L/ha. Apply once per season before planting or transplanting. May also be applied to a 15 m strip adjacent to fence rows. Use the low rate except under conditions of low soil moisture. Use the high rate if the top 1 cm of soil is dry. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm. SEEDLING TREATMENT **EC and WP formulations:** Apply 1152–2304 g a.i. in 200–400 L/ha. Apply as a broadcast spray at the 2- to 5-leaf stage. Use the low rate except under conditions of low soil moisture. Use the high rate if the top 1 cm of soil is dry.
POTATO	**EC and WP formulations:** Ground application only (do not apply by aircraft). Do not apply more than once per season. Do not apply within 7 days of harvest. Do not enter treated fields to conduct scouting, hand weeding or irrigation activities until 1 day after application.
Colorado potato beetle (larvae), potato flea beetle, tarnished plant bug	**EC formulation:** Apply 480 g a.i. in 400–800 L/ha as a foliar spray.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray 3–7 days before planting. Do not incorporate. Also apply to a 15 m strip into adjacent fence rows. SEEDLING TREATMENT **EC and WP formulations:** Apply 562–1152 g a.i. in 200–400 L/ha. Apply once as a broadcast spray when damage first appears.
SUNFLOWER	**EC formulation:** Application is permitted by ground application equipment or aircraft where specified. Do not apply more than once per season. Do not apply within 42 days of harvest. Do not enter treated fields until 1 day after application.
Army cutworm, pale western cutworm, redbacked cutworm	**EC formulation:** Ground application only (do not apply by aircraft). Apply 576 g a.i. in 50–200 L/ha. Do not apply by aircraft. Apply as a broadcast spray when damage first appears. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm.
Seed weevil	**EC formulation:** Ground or aerial application. Apply 576 g a.i. in at least 20 L/ha. Apply in late July to early August when populations of weevils are observed in the sunflower heads.

Sites and Pests	Rates and Directions
SUGARBEET	**EC formulation:** Ground application only (do not apply by aircraft). Do not apply more than once per season. Do not apply within 90 days of harvest. Do not enter treated fields until 1 day after application.
Pale western cutworm, redbacked cutworm	**EC formulation:** Apply 576–1152 g a.i. in 50–200 L/ha. Apply as a broadcast spray to crop seedlings when damage first appears. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm.
BARLEY, WHEAT, OATS	**EC formulation:** Do not apply more than once per season to barley or wheat. Do not apply within 60 days of harvest. Application is permitted by ground application equipment or aircraft where specified. Do not enter treated fields until 1 day after application.
Armyworm (including bertha armyworm), army cutworm, darksided cutworm, pale western cutworm, redbacked cutworm	**EC formulation:** Apply 420–576 g a.i. in 50–200 L/ha for ground application equipment or in 10–30 L/ha for aircraft. Apply to soil or foliage. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm.
Grasshoppers	**EC formulation:** Apply 278.4–420 g a.i. in 50–200 L/ha for ground application equipment, or in 10–30 L/ha for aircraft. Apply as a broadcast foliar spray. Use the low rate for juvenile grasshoppers and the high rate for adults. Treat adjacent ungrazed and unoccupied areas such as roadsides, rights-of-way and fence lines at the first sign of infestation.
Brown wheat mite	**EC formulation:** Apply 300 g a.i. in 50–200 L/ha for ground application equipment or in 10–30 L/ha for aircraft. Apply as a foliar spray.
Russian wheat aphid	**EC formulation:** Apply 240 g a.i. in a minimum of 100 L/ha for ground application equipment or in a minimum of 20 L/ha for aircraft. Apply as a foliar spray.
Orange wheat blossom midge (WHEAT only)	**EC formulation:** Apply 398–480 g a.i. in 50–200 L/ha for ground application. Apply 480 g a.i. in 10–30 L/ha for aerial application. Apply when adults reach the economic threshold and when 25% of the wheat heads have emerged from the boot, but preferably delay spraying until 30% of the crop is flowering. Timing is critical to ensure good control. Applications should be made in the late afternoon or early evening when temperatures exceed 15°C and wind speed is less than 10 km/h.
ONION (bulb, pickling)	**GR, EC and WP formulations:** Ground application only (do not apply by aircraft). Do not apply more than once per season. Do not enter treated fields until 1 day after application. Do not apply to bunching onions. [See also below.] **GR formulation:** Do not apply within 109 days of harvest for bulb onions, or 97 days of harvest for pickling onions. **EC and WP formulations:** Do not apply within 60 days of harvest.

Sites and Pests	Rates and Directions
Onion maggot	**GR formulation:** Apply 1.2–2.4 kg a.i./ha, as follows: **Row Spacing** **kg a.i./ha** 2.5–5 cm 1.2 7.5 cm 1.8 10–15 cm 2.4 Apply as an in-furrow at-plant treatment.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152–2304 g a.i. in 200–400 L/ha. Apply once per season before planting or transplanting. Application is also permitted on a 15 m strip adjacent to fence rows. Use the low rate except under conditions of low soil moisture. Use the high rate if the top 1 cm of soil is dry. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm. SEEDLING TREATMENT **EC and WP formulations:** Apply 1125–2304 g a.i. in 200–400 L/ha. Apply as a broadcast spray at the 2- to 5-leaf stage. Use the low rate except under conditions of low soil moisture. Use the high rate if the top 1 cm of soil is dry.
TOBACCO	**EC and WP formulations:** Do not apply more than once per season. Ground application only (do not apply by aircraft). Do not enter treated fields until 1 day after application.
Black cutworm, darksided cutworm, redbacked cutworm	SOIL TREATMENT **EC formulation:** Apply 1152–2304 g a.i. in 200–400 L/ha. Apply once, 3–7 days before planting or transplanting. If the top 1 cm or more of soil is dry, use the higher rate. When preplant soil applications are being made to muck soil, do not incorporate. Incorporation on mineral soils should be no deeper than 5 cm. Also apply to a 15 m strip into adjacent cover crop and to fence rows.
Darksided cutworm	COVER CROP TREATMENT **EC formulation:** Apply 540–576 g a.i. in 200–400 L/ha. Darksided cutworms may feed on the cover crop before spring plough-down. Apply to the area planted to tobacco and to a strip about 15 m into nearby cover crop and fence rows. Application should be made in mid to late April, 4 to 5 days before plough-down. When the rye cover crop is about 15 cm tall, the cutworm larvae will be at the right stage for the best control. Cereals grown for cover crop treated with this insecticide should not be used for human or animal consumption if treated within 60 days of harvest.
Seedcorn maggot	TRANSPLANT WATER TREATMENT **WP formulation:** Apply 68.75 g a.i./1000 L (200–240 g a.i./ha). Apply 200 mL of solution with each plant. Keep mixture well agitated. Do not use starter fertilizers with this product.

Sites and Pests	Rates and Directions
FILBERT	**EC formulation:** Do not apply more than three times per season. Do not apply within 14 days of harvest. Ground application only (do not apply by aircraft). Do not enter treated fields until 4 days after application to conduct scouting activities.
Filbert aphid	**EC formulation:** Apply 2016–2304 g a.i. in 100 L/ha. Apply as a foliar spray with ground application only using an airblast sprayer. Direct nozzles of air blast sprayer into the orchard when spraying border rows.
FOREST: LODGEPOLE PINE	**EC formulation:** Ground application only (do not apply by aircraft). For use in Western Canada only.
Mountain pine beetle	**Restricted Use** NATURE OF RESTRICTION: This product is to be used only in the manner authorized. Contact local pesticide regulatory authorities about appropriate use permits that may be required. To be applied only under the direct supervision of commercial applicator responsible for insect control programs. **EC formulation:** For ground use only to control small infestations of mountain pine beetle in lodgepole pine forest stands. Monitor stands from mid-June to mid-July to determine the trees that are infested. Treated infested trees within a few weeks of expected beetle emergence, usually early July, to kill the adult beetles. Avoid spraying when conditions favour drift from spray area. Prepare a spray solution of 20 kg a.i./1000 L of water to make a spray containing 2% active ingredient by weight. Apply at a rate of 1 L spray /m^2 of bark prior to adult beetle emergence. Treat boles from ground level up to a height of at least 3 m or until a bole diameter of 12.5 cm is reached.

DISPOSAL

Registrants should consult Regulatory Directive DIR99-04, *Disposal Statements for Control Product Labels*, for statements applicable to their product.

Appendix III Additional Label Requirements for Non-Agricultural Uses of Chlorpyrifos as an Outcome of Phase 2

Regulatory decisions were taken as part of the Phase 1 re-evaluation of chlorpyrifos that resulted in actions affecting mainly non-agricultural uses, as described below.

Residential Uses of Domestic and Commercial Class Products (lawns, gardens and structures)

All Domestic and Commercial class products with residential uses (both indoor and outdoor) have been phased out, with the exception of containerized, low-concentration baits, which are acceptable for continuing registration.

Turf Uses

Use on turf is limited to treatment of golf courses, industrial sites, highway medians and sod farms only.

Structural Pest Control

Uses inside and outside commercial buildings have been limited to the following scenarios, where public access is limited:

- crack and crevice in ship holds, railroad boxcars, industrial plants, manufacturing plants, warehouses, meat packing plants and food processing plants;
- spot treatment in industrial plants, manufacturing plants, warehouses, meat packing plants and food processing plants;
- bait treatment in food processing plants, meat packing plants as well as warehouses; and
- perimeter soil treatment or localized areas on outside surfaces of industrial plants, manufacturing plants, warehouses, meat packing plants and food processing plants.

Farm and Livestock Buildings

These uses have been limited to treatment of farm buildings (in and around dairy cattle, beef cattle, swine, sheep, poultry), feedlots, corrals, stockyards, holding pens and other livestock holding areas.

Ornamentals

Uses for treatment of ornamentals have been limited to the following:

- treatment of ornamentals for commercial production only (greenhouses, nurseries and industrial sites); and
- treatment of elm for control of adult bark beetles (Restricted Use to be used only under a provincial Dutch elm disease program).

Mosquito Control

Restricted uses for mosquito control (larvae and adults) are maintained.

As an outcome of the Phase 2 re-evaluation, additional measures affecting these uses are now required to address worker safety concerns. The registrations of products labelled for these uses must be amended to reflect the new labelling requirements as follows.

TOXICOLOGICAL INFORMATION

The **TOXICOLOGICAL INFORMATION** statement of the labels for all chlorpyrifos products must be upgraded to state the following:

> Chlorpyrifos is an organophosphate that is a cholinesterase inhibitor. Typical symptoms of overexposure to cholinesterase inhibitors include headache, nausea, dizziness, sweating, salivation, runny nose and eyes. This may progress to muscle twitching, weakness and tremor in coordination, vomiting, abdominal cramps and diarrhea in more serious poisonings. A life-threatening poisoning is signified by loss of consciousness, incontinence, convulsions and respiratory depression with a secondary cardiovascular component. Treat symptomatically. If exposed, plasma and red blood cell cholinesterase tests may indicate degree of exposure (baseline data are useful). Atropine, only by injection, is the preferable antidote. Oximes, such as pralidoxime chloride, may be therapeutic if used early; however, use only in conjunction with atropine. In cases of severe acute poisoning, use antidotes immediately after establishing an open airway and respiration. With oral exposure, the decision of whether to induce vomiting or not should be made by an attending physician.

For those products that contain more than 10% petroleum distillates, the following text should also be added to **TOXICOLOGICAL INFORMATION** section (placed at the end of the paragraph presented above), as an additional aid to the attending physician: "NOTE: Product contains a petroleum distillate solvent."

PRECAUTIONS FOR MIXERS/LOADERS

The labels for chlorpyrifos products, with the exception of containerized baits, must be amended to reflect the following measures for protection of mixers/loaders.

For liquid formulations packaged in containers more than 10 L

Mixers/loaders must use a closed mechanical transfer loading system. Mixers/loaders must wear:

- coveralls over a long-sleeved shirt and long pants;
- chemical-resistant gloves;
- an air purifying respirator with an -R or -P series filter; and
- socks and shoes.

For liquid formulations packaged in containers holding 10 L or less
Mixers/loaders must wear:

- coveralls over a long-sleeved shirt and long pants;
- chemical-resistant gloves;
- a chemical-resistant apron;
- chemical-resistant footwear plus socks; and
- an air purifying respirator equipped with an -R or -P series filter.

For wettable powder formulations (must be packaged in water-soluble bags)
Mixers/loaders must wear:

- a long-sleeved shirt and long pants;
- socks and shoes;
- chemical-resistant gloves; and
- chemical-resistant apron.

Mixers and loaders using water-soluble packets must have immediately available for use in emergency (such as a broken package, spill or equipment breakdown) additional PPE. These PPE include coveralls and chemical-resistant footwear and a non-powered air purifying respirator equipped with an -R or -P series filter.

For granular formulations
Mixers/loaders must wear:

- coveralls over a long-sleeved shirt and long pants;
- chemical-resistant gloves;
- chemical-resistant footwear and socks;
- an air purifying respirator equipped with an -R or -P series filter; and
- a chemical-resistant apron.

PRECAUTIONS FOR APPLICATORS

The labels for chlorpyrifos products, with the exception of containerized baits, must be amended as follows to reflect the following measures for protection of applicators.

Do not apply as a paintbrush treatment for indoor uses.

Do not apply with high-pressure handwand equipment.

Applicators using ground application equipment with a closed cab must wear:

- a long-sleeved shirt and long pants;
- chemical-resistant gloves when leaving cab for clean-up and repair (gloves must be removed and left outside when re-entering the cab); and
- socks and shoes.

Applicators using ground application equipment with an open cab must wear:

- coveralls over a long-sleeved shirt and long pants;
- chemical-resistant gloves; and
- socks and shoes.

Applicators using aerial application equipment must use enclosed cockpits and must wear:

- a long-sleeved shirt and long pants; and
- socks and shoes.

Applicators using handheld equipment must wear:

- a long-sleeved shirt and long pants;
- chemical-resistant coveralls and head protection (if spray is upwardly directed);
- chemical-resistant footwear and socks;
- chemical-resistant gloves; and
- an air purifying respirator with an -R or -P series filter.

PRECAUTIONS FOR POSTAPPLICATION WORKERS

Use on Greenhouse Ornamentals

Labels of chlorpyrifos products for use on greenhouse ornamentals must specify a re-entry interval of two days for workers conducting crop contact activities.

References

Citations associated with toxicological reference doses

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